

16-Channel, Constant-Current LED Driver with 4-Channel Grouped Delay

Check for Samples: [TLC59282](#)

FEATURES

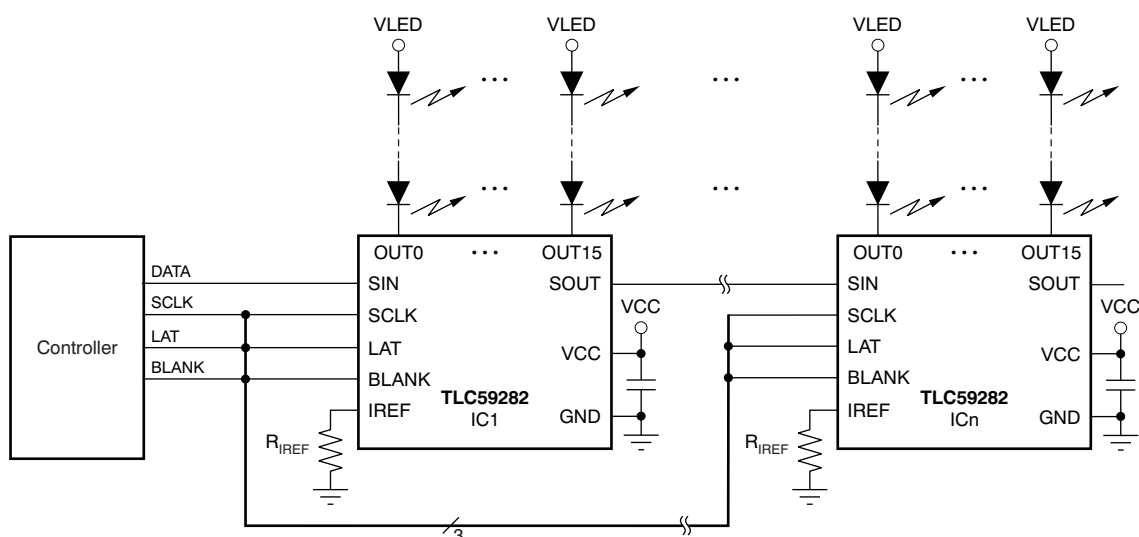
- 16 Channels, Constant-Current Sink Output with On/Off Control
- Capability (Constant-Current Sink): 35 mA ($V_{CC} \leq 3.6$ V), 45 mA ($V_{CC} > 3.6$ V)
- LED Power-Supply Voltage up to 17 V
- $V_{CC} = 3$ V to 5.5 V
- Constant-Current Accuracy:
 - Channel-to-Channel = $\pm 0.6\%$ (typ), $\pm 2\%$ (max)
 - Device-to-Device = $\pm 1\%$ (typ), $\pm 3\%$ (max)
- Low Saturation Voltage: 0.31 V at 20 mA (typ)
 - $T_A = +25^\circ\text{C}$, One Channel On
- CMOS Logic Level I/O
- Data Transfer Rate: 35 MHz
- BLANK Pulse Width: 30 ns
- Four-Channel Grouped Delay for Noise Reduction
- Operating Temperature: -40°C to $+85^\circ\text{C}$

APPLICATIONS

- Video Displays
- Message Boards
- Illumination

DESCRIPTION

The TLC59282 is a 16-channel, constant-current sink driver. Each channel can be individually controlled via a simple serial communications protocol that is compatible with 3.3 V or 5 V CMOS logic levels, depending on the operating VCC. Once the serial data buffer is loaded, a rising edge on LATCH transfers the data to the LEDx outputs. The BLANK pin can be used to turn off all OUTn outputs during power-on and output data latching to prevent unwanted image displays during these times. The constant-current value of all 16 channels is set by a single external resistor. Multiple TLC59282s can be cascaded together to control additional LEDs from the same processor.



Typical Application Circuit (Multiple Daisy-Chaind TLC59282s)



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This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

PACKAGE/ORDERING INFORMATION⁽¹⁾

PRODUCT	PACKAGE-LEAD	ORDERING NUMBER	TRANSPORT MEDIA, QUANTITY
TLC59282	SSOP-24/QSOP-24	TLC59282DBQR	Tape and Reel, 2500
		TLC59282DBQ	Tube, 50
TLC59282	QFN-24	TLC59282RGER	Tape and Reel, 3000
		TLC59282RGE	Tape and Reel, 250

- (1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or visit the device product folder at www.ti.com.

ABSOLUTE MAXIMUM RATINGS⁽¹⁾⁽²⁾

Over operating free-air temperature range, unless otherwise noted.

PARAMETER			TLC59282	UNIT
V _{CC}	Supply voltage		–0.3 to +6	V
I _{OUT}	Output current (dc)	OUT0 to OUT15	50	mA
V _{IN}	Input voltage range	SIN, SCLK, LAT, BLANK, IREF	–0.3 to V _{CC} + 0.3	V
V _{OUT}	Output voltage range	SOUT	–0.3 to V _{CC} + 0.3	V
		OUT0 to OUT15	–0.3 to +18	V
T _{J(MAX)}	Operating junction temperature		+150	°C
T _{STG}	Storage temperature range		–55 to +150	°C
ESD rating	Human body model (HBM)		4000	V
	Charged device model (CDM)		1000	V

- (1) Stresses above these ratings may cause permanent damage. Exposure to absolute maximum conditions for extended periods may degrade device reliability. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those specified is not supported.
- (2) All voltage values are with respect to network ground terminal.

THERMAL INFORMATION

THERMAL METRIC ⁽¹⁾		TLC59282		UNITS
		DBQ	RGE	
		24 PINS	24 PINS	
θ _{JA}	Junction-to-ambient thermal resistance	73.2	46.8	°C/W
θ _{JCTop}	Junction-to-case (top) thermal resistance	44.6	48.6	
θ _{JB}	Junction-to-board thermal resistance	38.9	23.0	
ψ _{JT}	Junction-to-top characterization parameter	12.3	1.2	
ψ _{JB}	Junction-to-board characterization parameter	39.7	22.9	
θ _{JCbot}	Junction-to-case (bottom) thermal resistance	n/a	6.3	

- (1) For more information about traditional and new thermal metrics, see the *IC Package Thermal Metrics* application report, [SPRA953](http://www.ti.com/lit/zip/spra953).

RECOMMENDED OPERATING CONDITIONS

At $T_A = -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$, unless otherwise noted.

PARAMETER		TEST CONDITIONS	TLC59282			UNIT
			MIN	NOM	MAX	
DC Characteristics: V _{CC} = 3 V to 5.5 V						
V _{CC}	Supply voltage		3		5.5	V
V _O	Voltage applied to output	OUT0 to OUT15			17	V
V _{IH}	High-level input voltage		0.7 × V _{CC}		V _{CC}	V
V _{IL}	Low-level input voltage		GND		0.3 × V _{CC}	V
I _{OH}	High-level output current	SOUT			−1	mA
I _{OL}	Low-level output current	SOUT			1	mA
I _{OLC}	Constant output sink current	OUT0 to OUT15, 3 V ≤ V _{CC} < 3.6 V	2		35	mA
		OUT0 to OUT15, 3.6 V ≤ V _{CC} < 5.5 V	2		45	mA
T _A	Operating free-air temperature range		−40		+85	°C
T _J	Operating junction temperature range		−40		+125	°C
AC Characteristics: V _{CC} = 3 V to 5.5 V						
f _{CLK} (SCLK)	Data shift clock frequency	SCLK			35	MHz
T _{WH0}	Pulse duration	SCLK	10			ns
T _{WL0}		SCLK	10			ns
T _{WH1}		LAT	20			ns
T _{WH2}		BLANK	60			ns
T _{WL2}		BLANK	30			ns
T _{SU0}		Setup time	SIN−SCLK↑	4		
T _{SU1}	LAT↓−SCLK↑		10			ns
T _{H0}	Hold time	SIN−SCLK↑	4			ns
T _{H1}		LAT↓−SCLK↑	10			ns

ELECTRICAL CHARACTERISTICS

At $V_{CC} = 3\text{ V}$ to 5.5 V and $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$. Typical values at $V_{CC} = 3.3\text{ V}$ and $T_A = +25^\circ\text{C}$, unless otherwise noted.

PARAMETER		TEST CONDITIONS	TLC59282			UNIT
			MIN	TYP	MAX	
V_{OH}	High-level output voltage	$I_{OH} = -1\text{ mA}$ at SOUT	$V_{CC} - 0.4$		V_{CC}	V
V_{OL}	Low-level output voltage	$I_{OL} = 1\text{ mA}$ at SOUT			0.4	V
I_{IN}	Input current	$V_{IN} = V_{CC}$ or GND at SIN and SCLK	-1		1	μA
I_{CC0}	Supply current (V_{CC})	SIN/SCLK/LAT = low, BLANK = high, $V_{OUTn} = 1\text{ V}$, $R_{IREF} = \text{open}$		0.1	1	mA
I_{CC1}		SIN/SCLK/LAT = low, BLANK = high, $V_{OUTn} = 1\text{ V}$, $R_{IREF} = 3\text{ k}\Omega$ ($I_{OUT} = 16.8\text{ mA}$ target)		4.5	6	mA
I_{CC2}		All $OUTn = \text{ON}$, SIN/SCLK/LAT/BLANK = low, $V_{OUTn} = 1\text{ V}$, $R_{IREF} = 3\text{ k}\Omega$		7	15	mA
I_{CC3}		All $OUTn = \text{ON}$, SIN/SCLK/LAT/BLANK = low, $V_{OUTn} = 1\text{ V}$, $R_{IREF} = 1.5\text{ k}\Omega$ ($I_{OUT} = 33.6\text{ mA}$ target)		16	34	mA
I_{OLC}	Constant output current	All $OUTn = \text{ON}$, $V_{OUTn} = V_{OUTfix} = 1\text{ V}$, $R_{IREF} = 1.5\text{ k}\Omega$ at $OUT0$ to $OUT15$ (see Figure 6), $T_A = +25^\circ\text{C}$	32.1	33.7	35.3	mA
I_{OLKG}	Output leakage current	$OUTn = \text{OFF}$, $V_{OUTn} = V_{OUTfix} = 17\text{ V}$, BLANK = high, $R_{IREF} = 1.5\text{ k}\Omega$ at $OUT0$ to $OUT15$ (see Figure 6)			0.1	μA
ΔI_{OLC0}	Constant-current error (channel-to-channel) ⁽¹⁾	All $OUTn = \text{ON}$, $V_{OUTn} = V_{OUTfix} = 1\text{ V}$, $R_{IREF} = 1.5\text{ k}\Omega$ at $OUT0$ to $OUT15$		± 0.6	± 2	%
ΔI_{OLC1}	Constant-current error (device-to-device) ⁽²⁾	All $OUTn = \text{ON}$, $V_{OUTn} = V_{OUTfix} = 1\text{ V}$, $R_{IREF} = 1.5\text{ k}\Omega$ at $OUT0$ to $OUT15$, $T_A = +25^\circ\text{C}$		± 1	± 3	%
ΔI_{OLC2}	Line regulation ⁽³⁾	All $OUTn = \text{ON}$, $V_{OUTn} = V_{OUTfix} = 1\text{ V}$, $R_{IREF} = 1.5\text{ k}\Omega$ at $OUT0$ to $OUT15$, $V_{CC} = 3\text{ V}$ to 5.5 V		± 0.5	± 1	%/V
ΔI_{OLC3}	Load regulation ⁽⁴⁾	All $OUTn = \text{ON}$, $V_{OUTn} = 1\text{ V}$ to 3 V , $V_{OUTfix} = 1\text{ V}$, $R_{IREF} = 1.5\text{ k}\Omega$		± 1	± 3	%/V
V_{IREF}	Reference voltage output	$R_{IREF} = 1.5\text{ k}\Omega$, $T_A = +25^\circ\text{C}$	1.18	1.205	1.23	V
R_{PUP}	Pull-up resistor	BLANK	250	500	750	k Ω
R_{PDWN}	Pull-down resistor	LAT	250	500	750	k Ω

- (1) The deviation of each output from the average of $OUT0$ – $OUT15$ constant-current. Deviation is calculated by the formula:

$$\Delta (\%) = \left[\frac{I_{OUTn}}{\frac{(I_{OUT0} + I_{OUT1} + \dots + I_{OUT14} + I_{OUT15})}{16}} - 1 \right] \times 100$$

- (2) The deviation of the $OUT0$ – $OUT15$ constant-current average from the ideal constant-current value. Deviation is calculated by the following formula:

$$\Delta (\%) = \left[\frac{\frac{(I_{OUT0} + I_{OUT1} + \dots + I_{OUT14} + I_{OUT15})}{16} - (\text{Ideal Output Current})}{\text{Ideal Output Current}} \right] \times 100$$

Ideal current is calculated by the formula:

$$I_{OUT(\text{IDEAL})} = 41.9 \times \left[\frac{1.205}{R_{IREF}} \right]$$

- (3) Line regulation is calculated by this equation:

$$\Delta (\%/V) = \left[\frac{(I_{OUTn} \text{ at } V_{CC} = 5.5\text{ V}) - (I_{OUTn} \text{ at } V_{CC} = 3\text{ V})}{(I_{OUTn} \text{ at } V_{CC} = 3\text{ V})} \right] \times \frac{100}{5.5\text{ V} - 3\text{ V}}$$

- (4) Load regulation is calculated by the equation:

$$\Delta (\%/V) = \left[\frac{(I_{OUTn} \text{ at } V_{OUTn} = 3\text{ V}) - (I_{OUTn} \text{ at } V_{OUTn} = 1\text{ V})}{(I_{OUTn} \text{ at } V_{OUTn} = 1\text{ V})} \right] \times \frac{100}{3\text{ V} - 1\text{ V}}$$

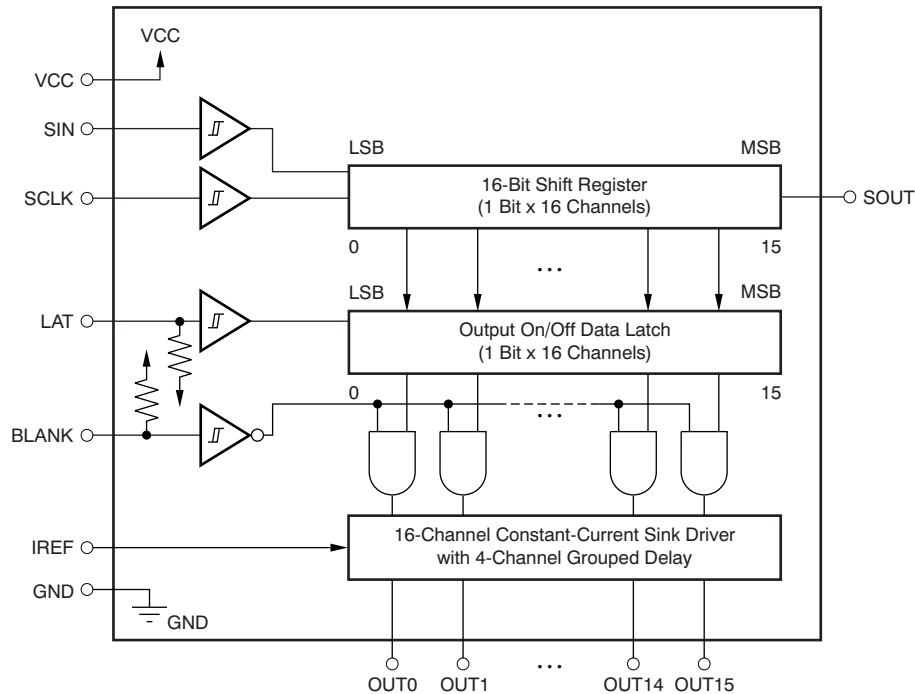
SWITCHING CHARACTERISTICS

At $V_{CC} = 3\text{ V}$ to 5.5 V , $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$, $C_L = 15\text{ pF}$, $R_L = 130\ \Omega$, $R_{REF} = 1.5\text{ k}\Omega$, and $V_{LED} = 5.5\text{ V}$. Typical values at $V_{CC} = 3.3\text{ V}$ and $T_A = +25^\circ\text{C}$, unless otherwise noted.

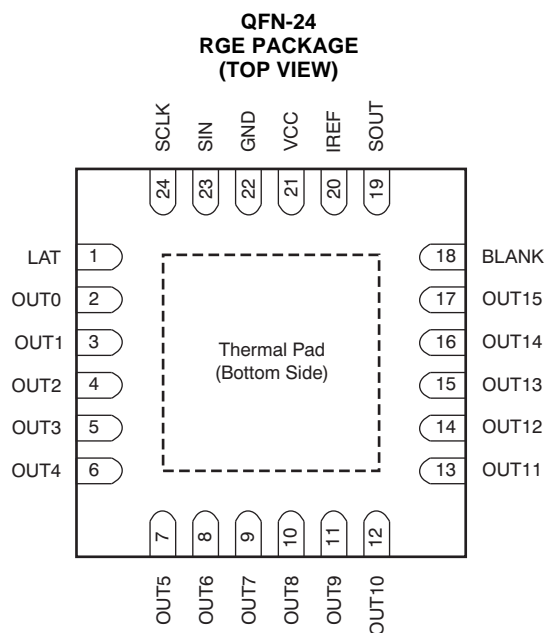
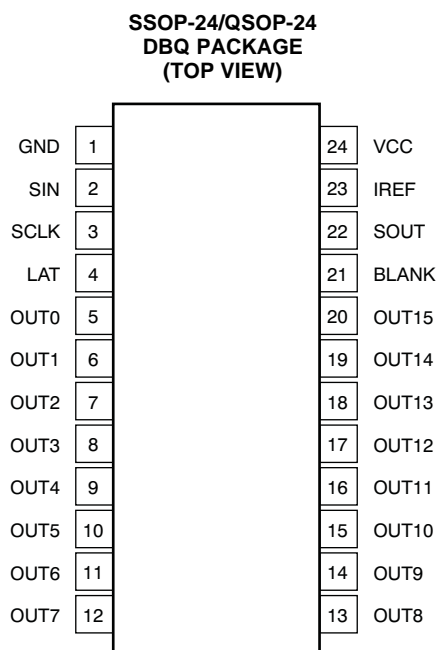
PARAMETER		TEST CONDITIONS	TLC59282			UNIT
			MIN	TYP	MAX	
t_{R0}	Rise time	SOUT (see Figure 5)		5	12	ns
t_{R1}		OUTn (see Figure 4)		10	30	ns
t_{F0}	Fall time	SOUT (see Figure 5)		5	12	ns
t_{F1}		OUTn (see Figure 4)		10	30	ns
t_{D0}	Propagation delay time	SCLK↑ to SOUT↑↓		8	20	ns
t_{D1}		LAT↑ or BLANK↑↓ to OUT0/OUT7/OUT8/OUT15 on/off		18	36	ns
t_{D2}		LAT↑ or BLANK↑↓ to OUT1/OUT6/OUT9/OUT14 on/off		38	69	ns
t_{D3}		LAT↑ or BLANK↑↓ to OUT2/OUT5/OUT10/OUT13 on/off		58	102	ns
t_{D4}		LAT↑ or BLANK↑↓ to OUT3/OUT4/OUT11/OUT12 on/off		78	135	ns
t_{ON_ERR}	Output on-time error ⁽¹⁾	On/off latch data = all '1', 30 ns BLANK low level one-shot pulse input	–15		15	ns

(1) Output on-time error (t_{ON_ERR}) is calculated by the formula: $t_{ON_ERR}\text{ (ns)} = t_{OUT_ON} - \text{BLANK low level one-shot pulse width (}T_{WL2}\text{)}$. t_{OUT_ON} indicates the actual on-time of the constant-current output.

FUNCTIONAL BLOCK DIAGRAM



DEVICE INFORMATION



NOTE: Thermal pad is not connected to GND internally. The thermal pad must be connected to GND via the PCB pattern.

TERMINAL FUNCTIONS

TERMINAL			I/O	DESCRIPTION
NAME	DBQ	RGE		
SIN	2	23	I	Serial data input for driver on/off control; Schmitt buffer input. When SIN is high, data '1' are written into the LSB of the 16-bit shift register at the SCLK rising edge.
SCLK	3	24	I	Serial data shift clock; Schmitt buffer input. All data in the 16-bit shift register are shifted toward the MSB by 1-bit synchronization of SCLK.
LAT	4	1	I	Level triggered latch; Schmitt buffer input. The data in the 16-bit shift register continue to transfer to the output on/off data latch while LAT is high. Therefore, if the data in the 16-bit shift register are changed when LAT is high, the data in the data latch are also changed. The data in the data latch are held when LAT is low. This pin is internally pulled down to GND with a 500 k Ω (typ) resistor.
BLANK	21	18	I	Blank, all outputs; Schmitt buffer input. When BLANK is high, all constant-current outputs (OUT0–OUT15) are forced off. When BLANK is low, all constant-current outputs are controlled by the data in the output on/off data latch. This pin is internally pulled up to V _{CC} with a 500 k Ω (typ) resistor.
IREF	23	20	I/O	Constant-current value setting, OUT0–OUT15 sink constant-current is set to desired value by connection to an external resistor between IREF and GND.
SOUT	22	19	O	Serial data output. This output is connected to the MSB of the 16-bit shift register. SOUT data changes at the rising edge of SCLK.
OUT0	5	2	O	Constant-current output. Each output can be tied together with others to increase the constant-current. Different voltages can be applied to each output.
OUT1	6	3	O	Constant-current output
OUT2	7	4	O	Constant-current output
OUT3	8	5	O	Constant-current output
OUT4	9	6	O	Constant-current output
OUT5	10	7	O	Constant-current output
OUT6	11	8	O	Constant-current output
OUT7	12	9	O	Constant-current output
OUT8	13	10	O	Constant-current output
OUT9	14	11	O	Constant-current output
OUT10	15	12	O	Constant-current output
OUT11	16	13	O	Constant-current output
OUT12	17	14	O	Constant-current output
OUT13	18	15	O	Constant-current output
OUT14	19	16	O	Constant-current output
OUT15	20	17	O	Constant-current output
VCC	24	21	—	Power-supply voltage
GND	1	22	—	Power ground

PARAMETER MEASUREMENT INFORMATION

PIN EQUIVALENT INPUT AND OUTPUT SCHEMATIC DIAGRAMS

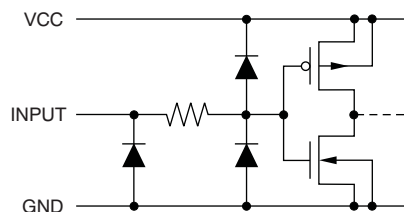


Figure 1. SIN, SCLK, LAT, BLANK

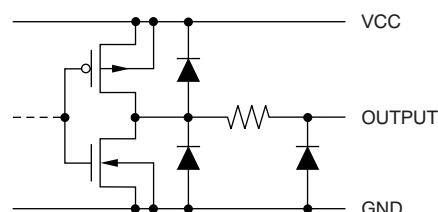


Figure 2. SOUT

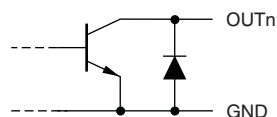
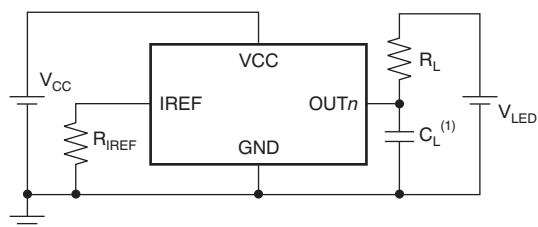


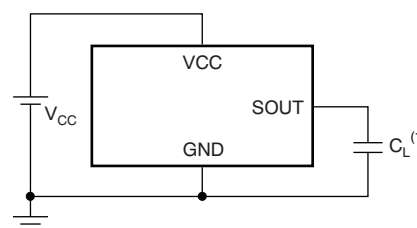
Figure 3. OUT0 Through OUT15

TEST CIRCUITS



(1) C_L includes measurement probe and jig capacitance.

Figure 4. Rise Time and Fall Time Test Circuit for OUTn



(1) C_L includes measurement probe and jig capacitance.

Figure 5. Rise Time and Fall Time Test Circuit for SOUT

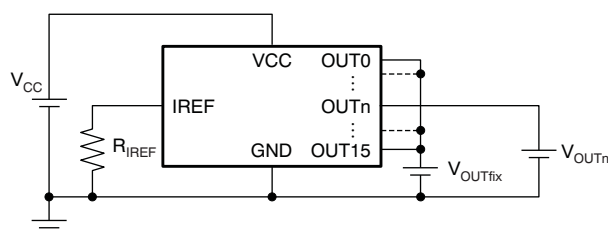
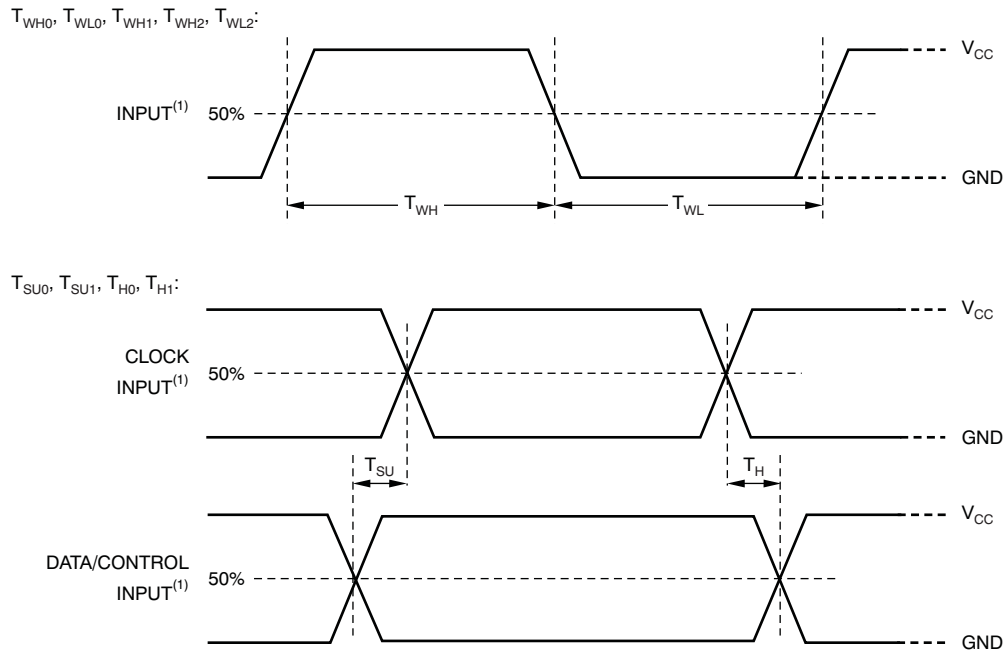


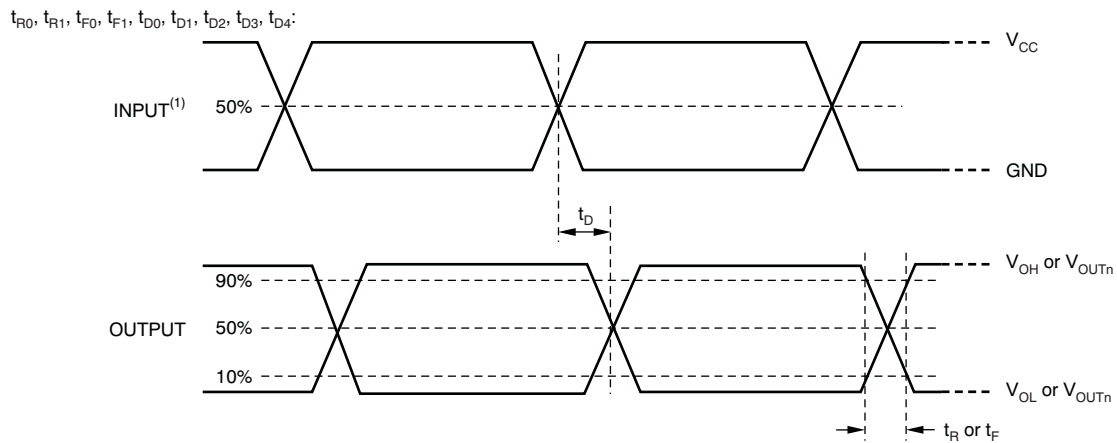
Figure 6. Constant-Current Test Circuit for OUTn

TIMING DIAGRAMS



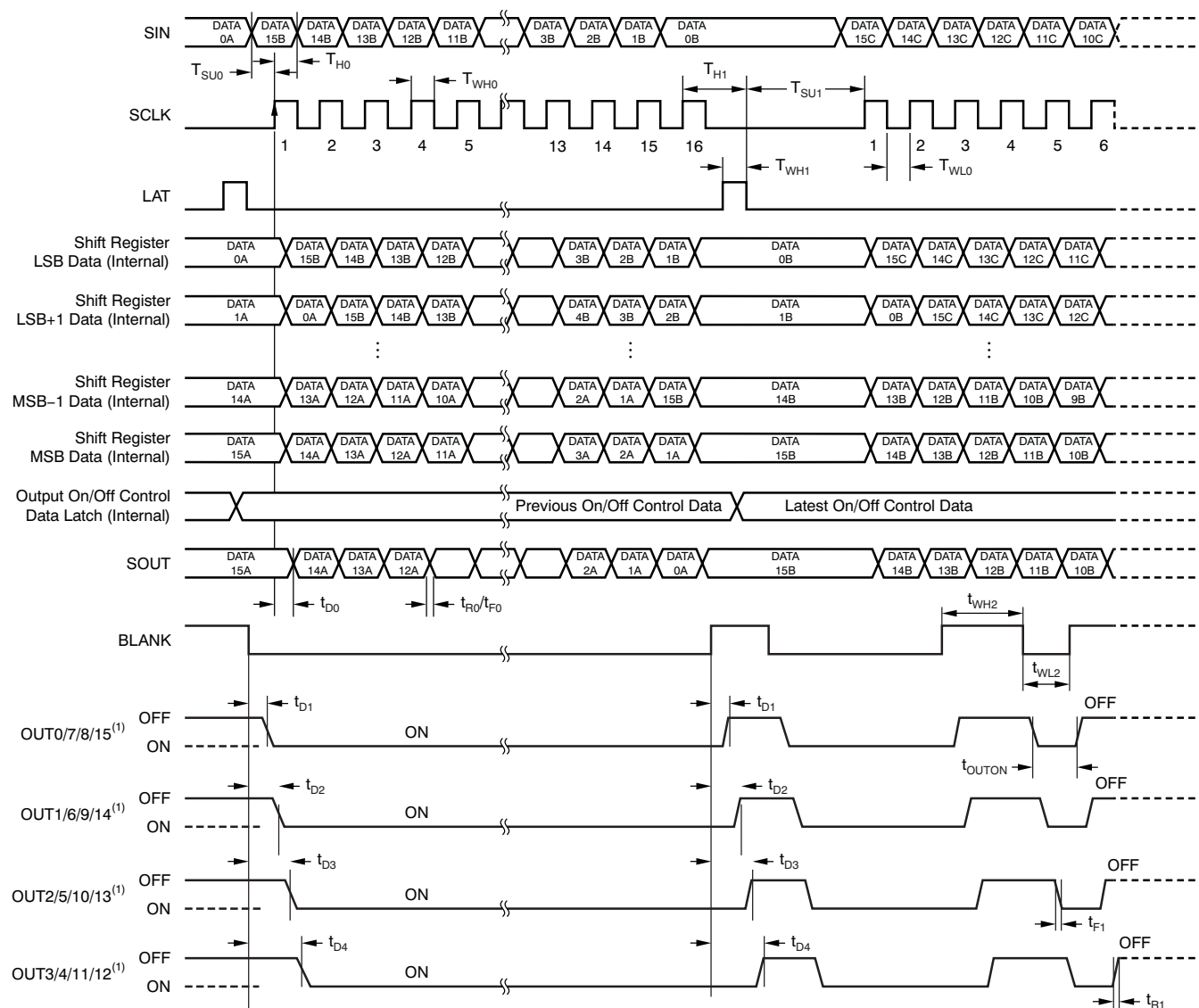
(1) Input pulse rise and fall time is 1 ns to 3 ns.

Figure 7. Input Timing



(1) Input pulse rise and fall time is 1 ns to 3 ns.

Figure 8. Output Timing



(1) Output on/off data = FFFFh.

(2) $t_{ON_ERR} = t_{OUTON} - T_{WL2}$.

Figure 9. Timing Diagram

TYPICAL CHARACTERISTICS

At $V_{CC} = 3.3\text{ V}$ and $T_A = +25^\circ\text{C}$, unless otherwise noted.

**REFERENCE RESISTOR
vs OUTPUT CURRENT**

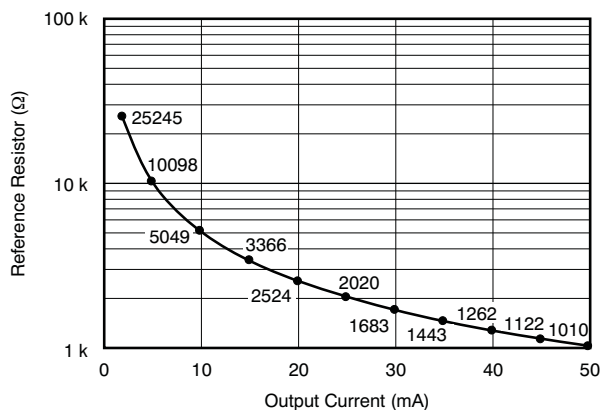


Figure 10.

**OUTPUT CURRENT vs
OUTPUT VOLTAGE**

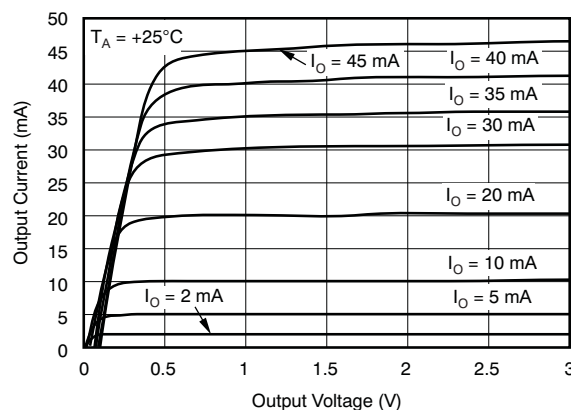


Figure 11.

**OUTPUT CURRENT vs
OUTPUT VOLTAGE**

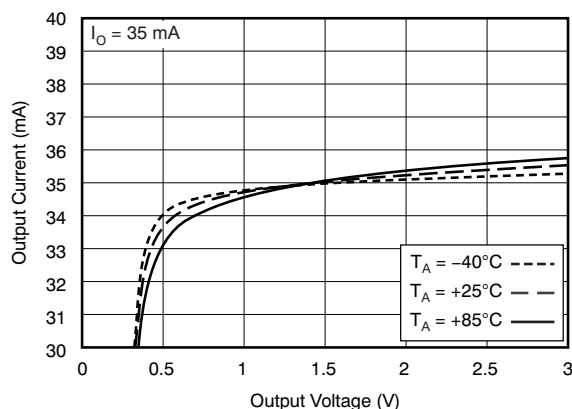


Figure 12.

ΔI_{OLC} vs AMBIENT TEMPERATURE

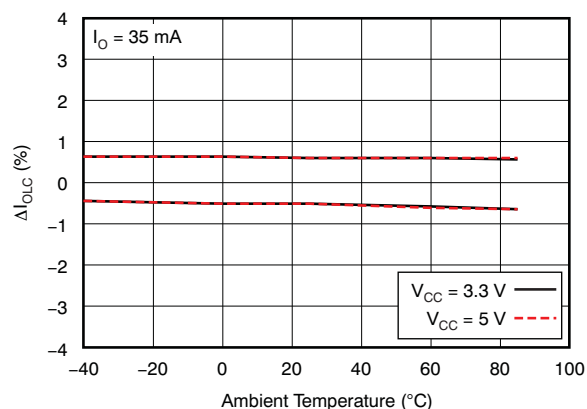


Figure 13.

ΔI_{OLC} vs OUTPUT CURRENT

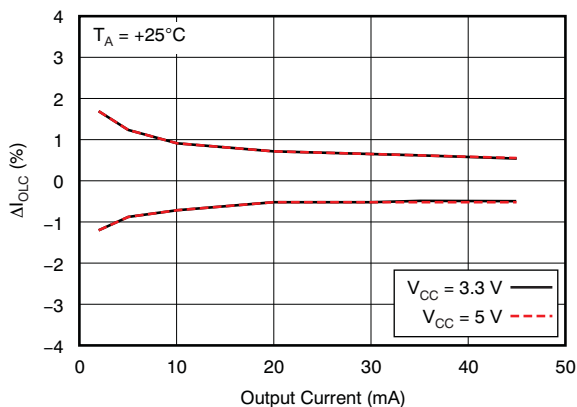


Figure 14.

**CONSTANT-CURRENT OUTPUT
VOLTAGE WAVEFORM**

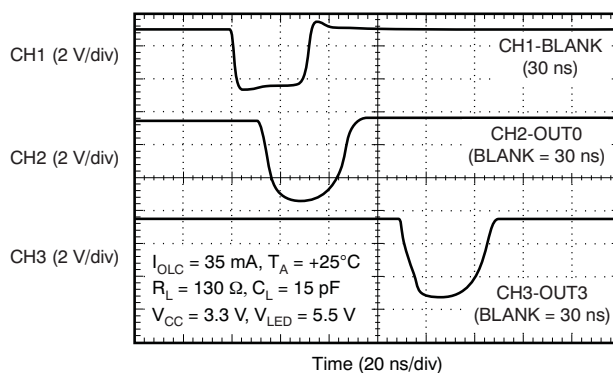


Figure 15.

DETAILED DESCRIPTION

SETTING FOR THE CONSTANT SINK CURRENT VALUE

The constant-current values are determined by an external resistor (R_{IREF}) placed between IREF and GND. The resistor (R_{IREF}) value is calculated by [Equation 1](#).

$$R_{IREF} (k\Omega) = \frac{V_{IREF} (V)}{I_{OLC} (mA)} \times 41.9$$

Where:

V_{IREF} = the internal reference voltage on the IREF pin (typically 1.205 V) (1)

I_{OLC} must be set in the range of 2 mA to 35 mA when V_{CC} is less than 3.6 V. Also, when V_{CC} is equal to 3.6 V or greater, I_{OLC} must be set in the range of 2 mA to 45 mA. The constant sink current characteristic for the external resistor value is shown in [Figure 10](#). [Table 1](#) describes the constant-current output versus external resistor value.

Table 1. Constant-Current Output versus External Resistor Value

I_{OLC} (mA, Typical)	R_{IREF} (k Ω)
45 ($V_{CC} > 3.6$ V only)	1.12
40 ($V_{CC} > 3.6$ V only)	1.26
35	1.44
30	1.68
25	2.02
20	2.52
15	3.37
10	5.05
5	10.1
2	25.2

CONSTANT-CURRENT DRIVER ON/OFF CONTROL

When BLANK is low, the corresponding output is turned on if the data in the on/off control data latch are '1' and remains off if the data are '0'. When BLANK is high, all outputs are forced off. This control is shown in [Table 2](#).

Table 2. On/Off Control Data Truth Table

OUTPUT ON/OFF DATA	CONSTANT-CURRENT OUTPUT STATUS
0	Off
1	On

When the IC is initially powered on, the data in the 16-bit shift register and output on/off data latch are not set to the respective default value. Therefore, the output on/off data must be written to the data latch before turning the constant-current output on. BLANK should be at a high level when powered on because the constant-current may be turned on as a result of random data in the output on/off data latch.

The output on/off data corresponding to any unconnected OUTn outputs should be set to '0' before turning on the remaining outputs. Otherwise, the supply current (I_{CC}) increases while the LEDs are on.

REGISTER CONFIGURATION

The TLC59282 has a 16-bit shift register and an output on/off data latch. Both the shift register and data latch are 16 bits long and are used to turn the constant-current outputs on and off. [Figure 16](#) shows the shift register and data latch configuration. The data at the SIN pin are shifted in to the LSB of the 16-bit shift register at the rising edge of the SCLK pin; SOUT data change at the rising edge of SCLK.

The output on/off data in the 16-bit shift register continue to transfer to the output on/off data latch while LAT is high. Therefore, if the data in the 16-bit shift register are changed when LAT is high, the data in the data latch are also changed. The data in the data latch are held when LAT is low. When the IC initially powers on, the data in the output on/off shift register and latch are not set to the default values; on/off control data must be written to the on/off control data latch before turning the constant-current output on. BLANK should be high when the IC is powered on because the constant-current may be turned on at that time as a result of random values in the on/off data latch. All constant-current outputs are forced off when BLANK is high. The OUT_n on/off are controlled by the data in the output on/off data latch. The timing diagram and truth table for writing data are shown in [Figure 17](#) and [Table 3](#).

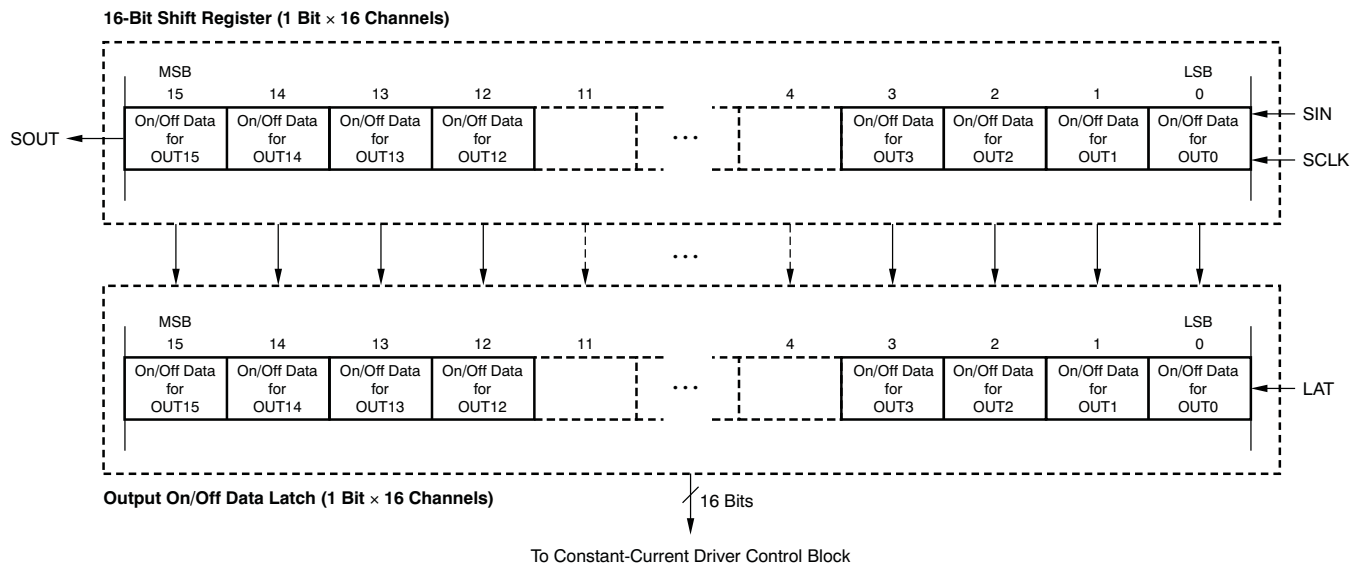


Figure 16. 16-Bit Shift Register and Output On/Off Data Latch Configuration

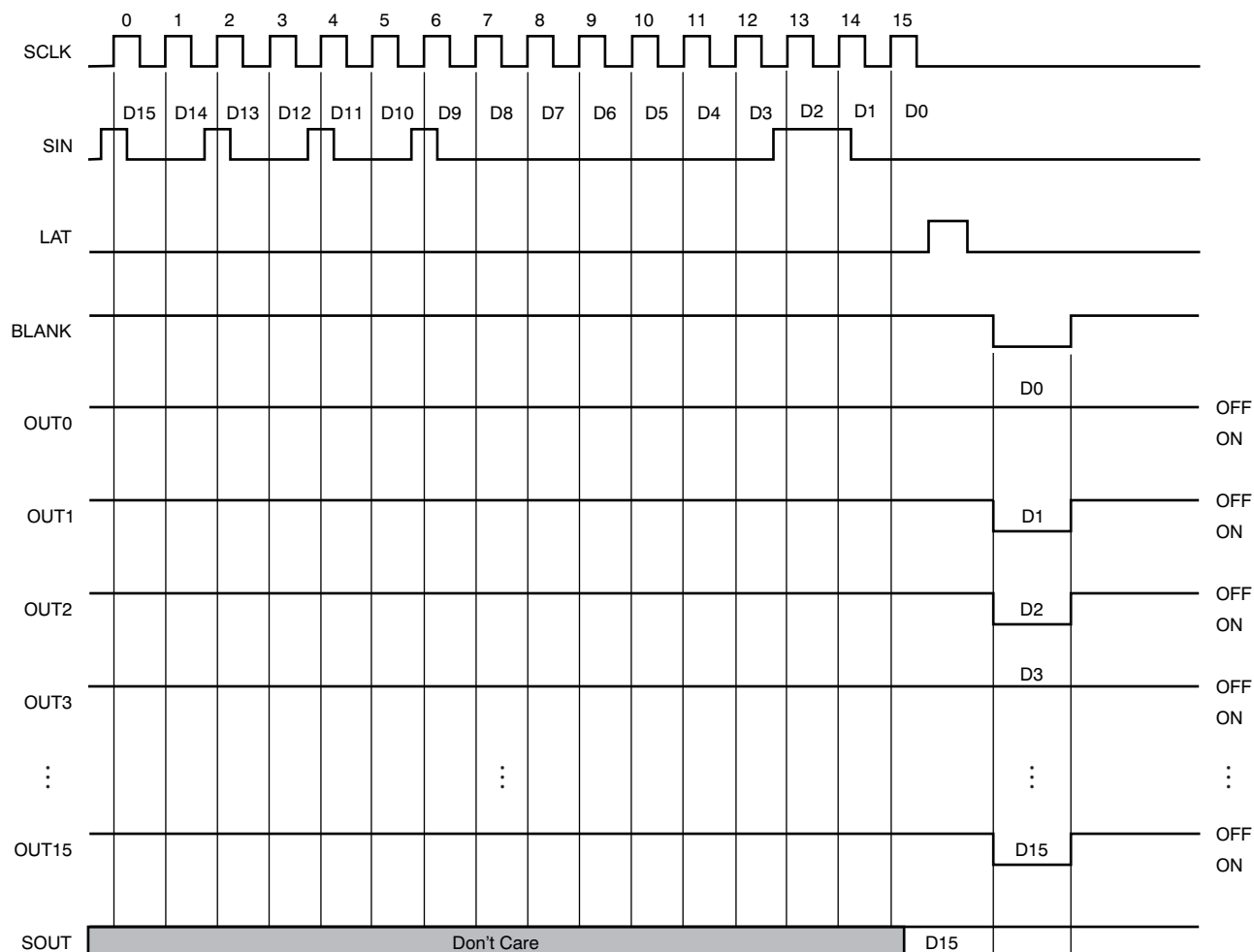


Figure 17. Operation Timing Diagram

Table 3. Truth Table in Operation

SCLK	LAT	BLANK	SIN	OUT0...OUT7...OUT15	SOUT
↑	High	Low	Dn	Dn...Dn – 7...Dn – 15	Dn – 15
↑	Low	Low	Dn + 1	No change	Dn – 14
↑	High	Low	Dn + 2	Dn + 2...Dn – 5...Dn – 13	Dn – 13
↓	—	Low	Dn + 3	Dn + 2...Dn – 5...Dn – 13	Dn – 13
↓	—	High	Dn + 3	Off	Dn – 13

NOISE REDUCTION

Large surge currents may flow through the IC and the board if all 16 outputs turn on or off simultaneously. These large current surges could induce detrimental noise and electromagnetic interference (EMI) into other circuits. The TLC59282 independently turns on or off the outputs for each color group with a 20 ns (typ) delay time; see [Figure 9](#). The output current sinks are grouped into four groups. The first group that is turned on/off are OUT0/7/8/15; the second group that is turned on/off are OUT1/6/9/14; the third group that is turned on/off are OUT2/5/10/13; and the fourth group is OUT3/4/11/12. Both turn-on and turn-off are delayed. However, the state of each output is controlled by the data in the output on-off data latch and BLANK level.

REVISION HISTORY

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision B (July 2011) to Revision C

Page

- Added *Low Saturation Voltage* Features bullet 1

Changes from Revision A (December 2010) to Revision B

Page

- Changed Constant-Current Accuracy Features bullet 1
- Added RGE package information to *Package/Ordering Information* table 2
- Added RGE package to *Thermal Information* table 2
- Changed *Input current* parameter test conditions in Electrical Characteristics table 4
- Added RGE pin out and footnote to *Device Information* section 6
- Added RGE information to *Terminal Functions* table 7
- Deleted Figure 11, *POWER DISSIPATION RATE vs FREE-AIR TEMPERATURE* 11

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/ Ball Finish	MSL Peak Temp ⁽³⁾	Samples (Requires Login)
TLC59282DBQ	ACTIVE	SSOP	DBQ	24	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	
TLC59282DBQR	ACTIVE	SSOP	DBQ	24	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	
TLC59282RGER	ACTIVE	VQFN	RGE	24	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	
TLC59282RGET	ACTIVE	VQFN	RGE	24	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	

⁽¹⁾ The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSOLETE: TI has discontinued the production of the device.

⁽²⁾ Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

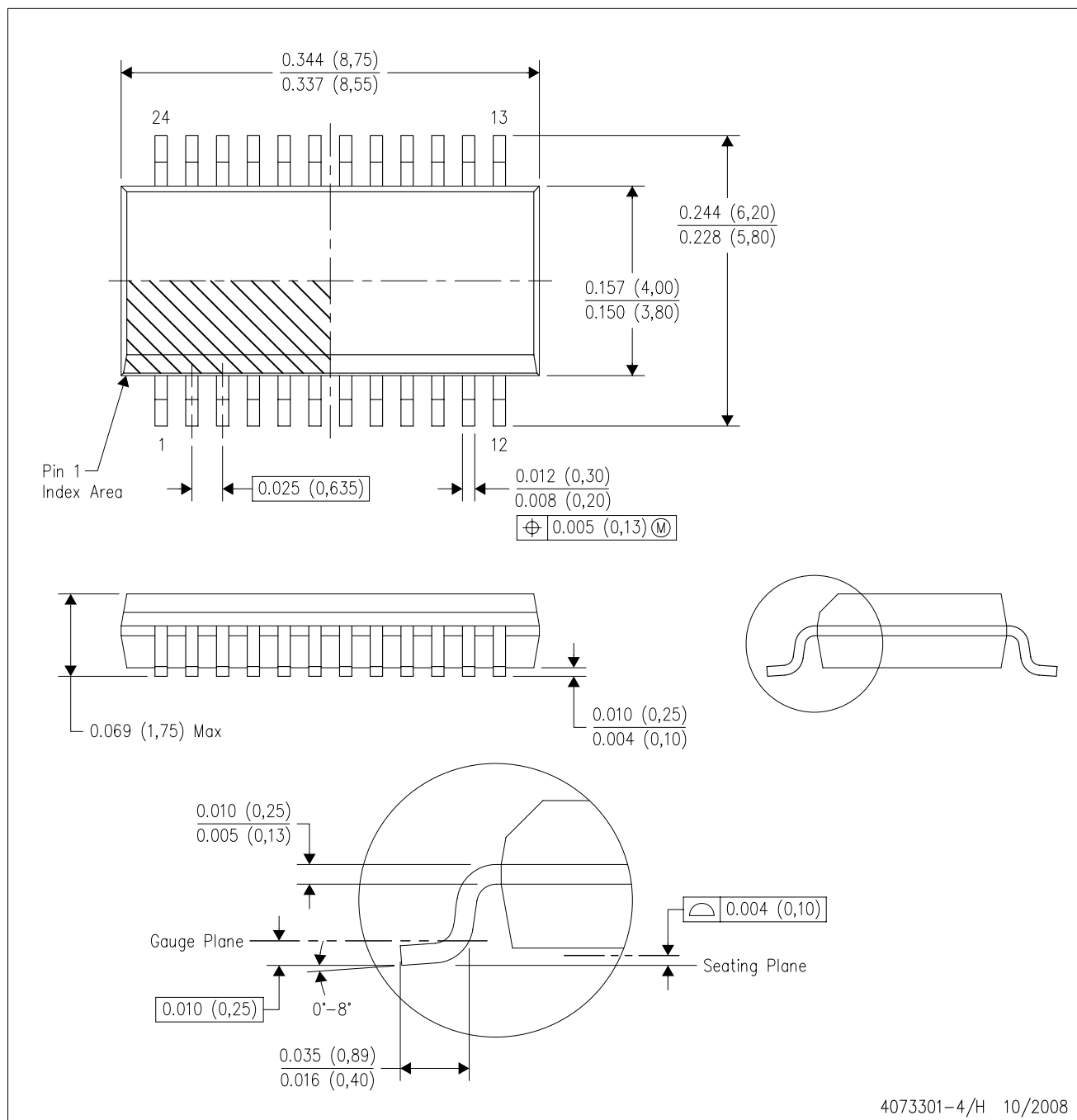
⁽³⁾ MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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DBQ (R-PDSO-G24)

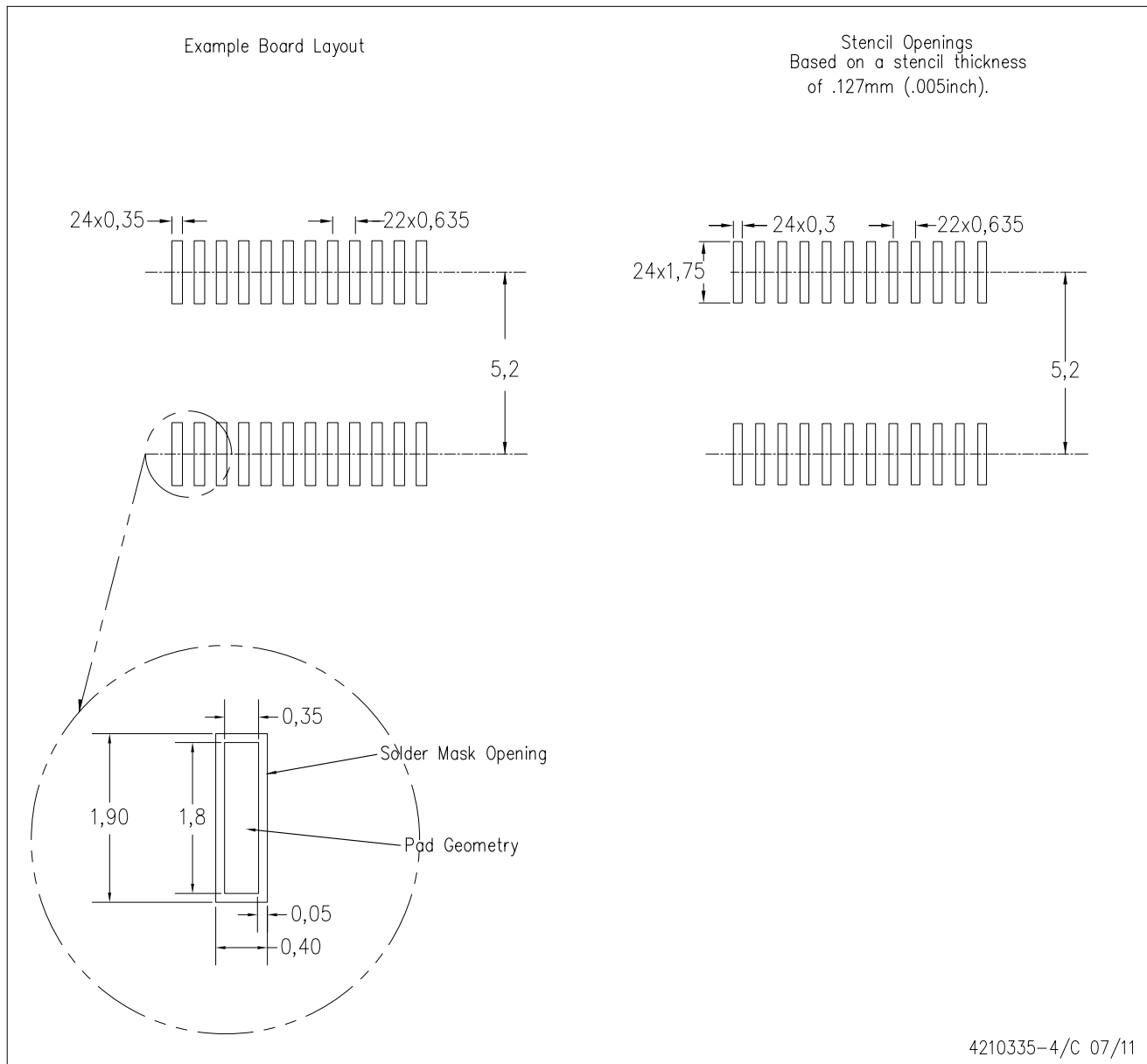
PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15) per side.
 - D. Falls within JEDEC MO-137 variation AE.

DBQ (R-PDSO-G24)

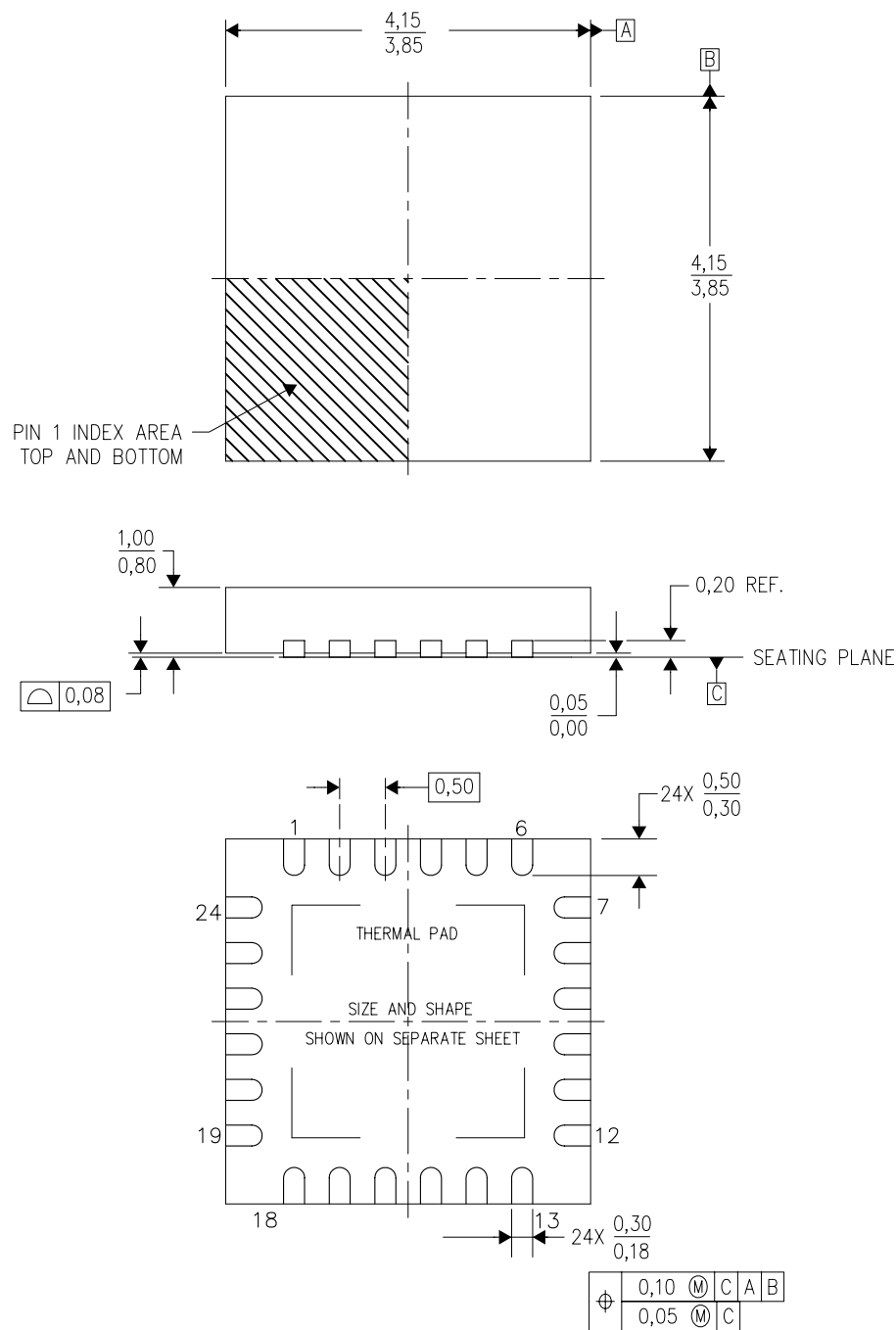
PLASTIC SMALL OUTLINE PACKAGE



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Customers should place a note on the circuit board fabrication drawing not to alter the center solder mask defined pad.
 - D. Publication IPC-7351 is recommended for alternate designs.
 - E. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Example stencil design based on a 50% volumetric metal load solder paste. Refer to IPC-7525 for other stencil recommendations.

RGE (S-PVQFN-N24)

PLASTIC QUAD FLATPACK NO-LEAD



4204104/G 07/11

- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
 - B. This drawing is subject to change without notice.
 - C. Quad Flatpack, No-Leads (QFN) package configuration.
 - D. The package thermal pad must be soldered to the board for thermal and mechanical performance.
 - E. See the additional figure in the Product Data Sheet for details regarding the exposed thermal pad features and dimensions.
 - F. Falls within JEDEC MO-220.

RGE (S-PVQFN-N24)

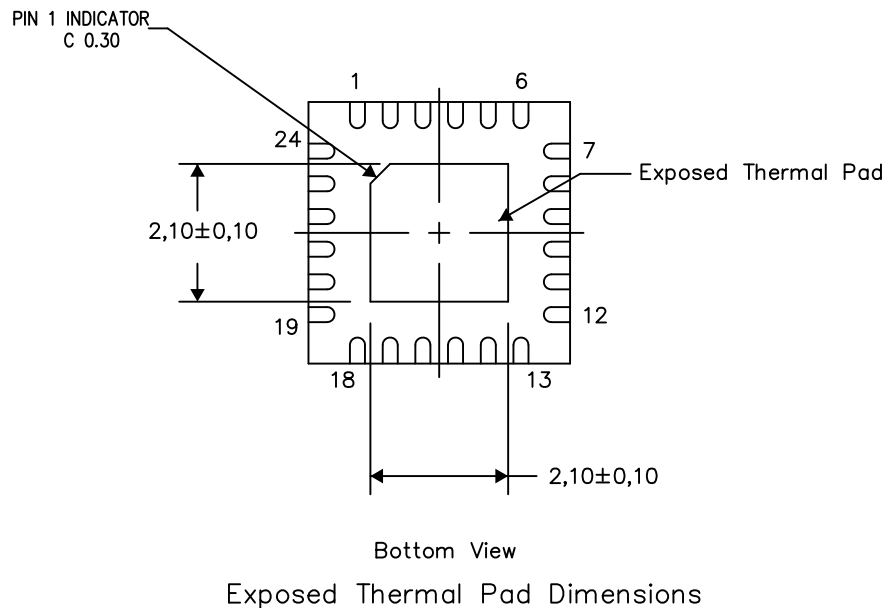
PLASTIC QUAD FLATPACK NO-LEAD

THERMAL INFORMATION

This package incorporates an exposed thermal pad that is designed to be attached directly to an external heatsink. The thermal pad must be soldered directly to the printed circuit board (PCB). After soldering, the PCB can be used as a heatsink. In addition, through the use of thermal vias, the thermal pad can be attached directly to the appropriate copper plane shown in the electrical schematic for the device, or alternatively, can be attached to a special heatsink structure designed into the PCB. This design optimizes the heat transfer from the integrated circuit (IC).

For information on the Quad Flatpack No-Lead (QFN) package and its advantages, refer to Application Report, QFN/SON PCB Attachment, Texas Instruments Literature No. SLUA271. This document is available at www.ti.com.

The exposed thermal pad dimensions for this package are shown in the following illustration.

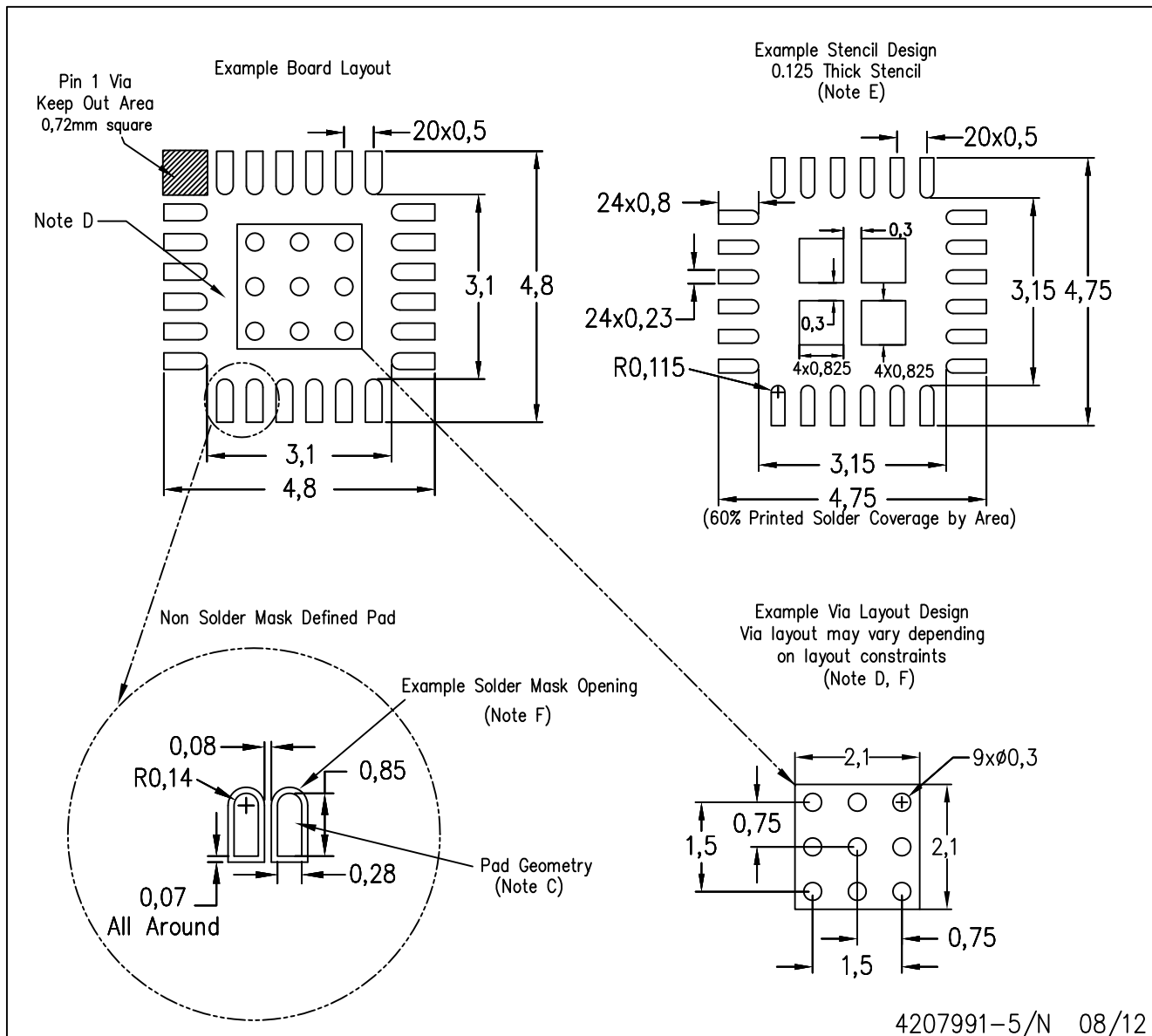


4206344-6/AB 09/12

NOTES: A. All linear dimensions are in millimeters

RGE (S-PVQFN-N24)

PLASTIC QUAD FLATPACK NO-LEAD



- NOTES:
- All linear dimensions are in millimeters.
 - This drawing is subject to change without notice.
 - Publication IPC-7351 is recommended for alternate designs.
 - This package is designed to be soldered to a thermal pad on the board. Refer to Application Note, Quad Flat-Pack Packages, Texas Instruments Literature No. SLUA271, and also the Product Data Sheets for specific thermal information, via requirements, and recommended board layout. These documents are available at www.ti.com <<http://www.ti.com>>.
 - Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC 7525 for stencil design considerations.
 - Customers should contact their board fabrication site for recommended solder mask tolerances and via tenting recommendations for vias placed in the thermal pad.

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